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COOKED, BONELESS TURKEY ROLLS: THE EFFECT OF GROUND SKIN AND FROZEN STORAGE ON QUALITY AND ACCEPTANCE

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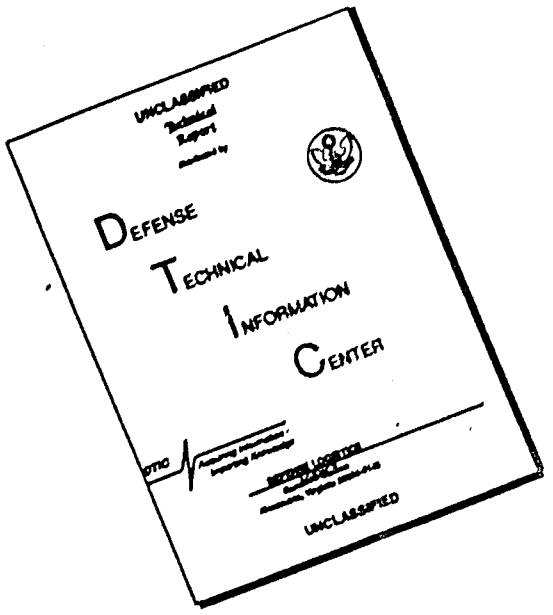

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A 1-yr storage study was conducted on cooked, boneless, turkey rolls with three levels of emulsified skin (0, 6 and 12%) incorporated into rolls with a 60:40 ratio of light to dark turkey meat. Sodium tripolyphosphate (0.5%, wt/wt) and salt 1.5% (wt/wt) were added as binding agents. Turkey rolls were stored at -17°C and evaluated at 0, 1, 2, 3, 6, 9 and 12 months. Addition of 6% emulsified skin into the turkey rolls had no significant effect on sensory panel scores. With 12% emulsified skin, color and appearance

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were the only sensory panel scores to show a significant decrease in value; whereas, odor, flavor and texture continued to show no significant change. Allo-Kramer shear values decreased significantly only at the 12% emulsified skin level indicating a more tender roll. Color values as determined by the Hunter color difference meter showed no significant changes in the redness or yellowness, but significant increases in lightness were noted at the 6 and 12% emulsified skin level. Storage of the cooked turkey rolls resulted in no significant change in any sensory panel score except appearance. As storage time increased there was visible darkening at the surface of the rolls. This was confirmed by a decrease in Hunter lightness values. While panel scores revealed no change in texture, shear values increased significantly throughout storage for all levels of skin.

FOREWORD

Cooked boneless turkey rolls have been the subject of numerous discussions between members of the Armed Forces Product Evaluation Committee and USA Natick Development Center primarily because of their poor quality. Previous studies have determined the effect of long term storage of frozen turkey meat and the use of binders in cooked turkey rolls. This study was initiated to determine the effect of various levels of skin incorporated into the roll on the quality of the cooked roll over a prolonged period of frozen storage. This study was conducted under Project No. 1T764713D548, Military Subsistence Systems, Task No. 21, New Subsistence Items for DOD Elements.

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COOKED, BONELESS TURKEY ROLLS: The effect of ground skin and frozen storage on quality and acceptance.

INTRODUCTION

Boneless cooked turkey rolls as purchased under Military Specification MIL-T-1660D have been the object of recent investigation. Research has been conducted to ascertain the effect of different additives as binding agents, the feasibility of using textured vegetable protein products as extenders, and the effect of prolonged freezer storage on texture and other quality characteristics of cooked boneless turkey rolls (1, 2, 5).

Under an Interim Federal Specification FP-T-00183 a cooked turkey roll may contain 12% ground skin. The turkey skin has long been used as a covering in the manufacturing of boneless turkey rolls; however, this has been found to be unsatisfactory. Incorporation of ground turkey skin into the product may reduce the cost of boneless turkey rolls. This study was initiated to investigate the effect of ground skin in cooked boneless turkey rolls on acceptability and storage stability.

Experimental

Frozen young tom turkeys weighing 20-25 lbs (9-11 kg) were obtained from a commercial source and were allowed to thaw over a 48-hr period at 40°F (4.5°C). The skin was removed, and the meat was boned and diced by hand into approximately 2-inch (5.0-cm) cubes. The turkey skin was ground twice through a meat grinder using a 0.125-inch (0.32-cm) plate. Turkey rolls weighing 4 lbs (1.8 kg) and having light to dark meat in a ratio of 60:40 were formulated with three levels of ground skin (0, 6, and 12% by weight). A binding agent consisting of 0.5% sodium tripolyphosphate and 1.5% NaCl was added to each roll.

The turkey meat, ground skin, and binding agent were mixed in a Hobart Mixer (Model N-50) for three minutes to insure thorough blending. After blending, the product was stuffed into cellulose casings, 3.5-inch (8.9-cm) in diameter and processed in hot water at 190°F (87°C) until an internal temperature of 170°F (76°C) was reached. Each roll was fabricated separately in random order with twenty-one replications/treatments, for a total of 63 cooked boneless turkey rolls.

The turkey rolls were frozen in a blast-freezer, packed in a sealed 1.5-m polyethylene film, and stored at 0°F (-18°C) until evaluated. Data were collected at 0, 1, 2, 3, 6, 9, and 12 months. Turkey rolls for the 0-time analysis were held at 40°F (4.5°C). Turkey rolls held at 0°F (-18°C) storage were allowed to thaw for 48 hrs at 40°F (4.5°C) until analyzed. Analysis was accomplished within 48 hrs after thawing.

Sensory evaluation of color, odor, flavor, texture and appearance was conducted by a panel of 15 food technologists following the procedures outlined by Larmond (3). Moisture was determined by placing the samples in a 158°F (70°C) oven with 20-inch (67.50 kPa) of vacuum for 24 hrs. Shear values were determined by using the Allo-Kramer Shear Press equipped with a CA-1 single blade shear cell and a 45.5-kg force ring. Slices of turkey 3-mm thick were used in sensory evaluation and shear force determination. Objective measurements for color were determined by using the Hunter Color Difference Meter using a white plate No. 2165 as a standard.

The experiment was designed using statistical methods described by Little & Hills with ground skin at three levels as one factor and time in storage at seven levels as another factor (4). The analysis of the data was accomplished by using the US Army Natick Development Center's Univac Model 1106 computer.

Results

Table 1: Cooking yields in grams, as affected by three levels of ground skin incorporated into turkey rolls

Percent skin	Mean raw weight	Mean wt after cooking	Mean cooking loss	Percent Mean loss	Cooking savings
0**	1839.05	1602.14	236.91	12.88[b]*	0.00
6	1830.71	1625.47	205.47	11.21[a]	1.67
12	1837.62	1630.00	207.62	11.30[a]	1.58

$P < .99$

* Any mean not followed by the same common letter differs significantly at the 1% level of probability as determined by Duncan's New Multiple Range Test.

** Observation treatment = 21.

The incorporation of 6 and 12% ground skin into turkey rolls resulted in a highly significant decrease in cooking loss (Table 1). Turkey rolls containing 6% skin had less cooking loss than those rolls with 0% skin. This cooking loss constitutes a savings of 1.67% of the total weight of the raw rolls. Rolls containing 12% skin also lost significantly less weight than those rolls with no skin (207.62 g compared to 236.91 g), or a savings of 1.58%. There was no significant difference between rolls containing 6 or 12% ground skin indicating a level or plateau of increased yields due to increased amounts of skin.

A possible reason for the increase in yield by the addition of skin can be related to available water in that skin contains less water than meat so that less water is available to be lost during cooking (6). Less cooking loss in turkey rolls due to incorporation of ground skin may produce an economic advantage in yield and thus less actual cost per pound.

These figures on increasing yield have a direct effect on the economic feasibility of using emulsified skin in cooked boneless turkey rolls. Turkey rolls containing ground skin should have a decrease in cost or an increase in acceptability or keeping quality to justify the use of ground skin in cooked turkey rolls.

Table 2: Percent moisture values for cooked turkey rolls containing three levels of ground skin and stored at 0°F (-18°C)

	Months in storage						
Percent skin	0	1	2	3	6	12	$\bar{X}$ for effect of % skin
0	67.99**	68.42	66.72	67.70	68.61	67.24	67.34^{c}*
6	67.11	65.99	67.46	65.31	66.63	67.73	66.26^{b}
12	65.87	66.28	64.69	65.11	64.31	66.49	64.80^{d}
$\bar{X}$ for effect of time	66.99	66.90	66.04	66.52	66.52	67.15	$\bar{\bar{X}}$ - 66.13 ± 2.09

$P < .99$

* Means of any column or row with the same letter are not significantly different at the 1% level of probability as judged by Duncan's New Multiple Range Test.

** Mean of 5 observations.

The effect of storage time, amount of ground skin, and their interaction had a significant influence ($P > .99$) on moisture values determined for cooked turkey rolls (Table 2). As the amount of ground skin was increased from 0 through 12%, the mean moisture values decreased. The difference in the amount of moisture between the three levels of ground skin was greater at the initial storage time than after 12 months of storage, but this trend was not found for the months of storage between the initial storage and the end of the study.

Regardless of the differences found between the levels of ground skin and the months in storage, increasing amounts of ground skin resulted in significantly decreasing moisture values. This decreasing moisture, as the amount of ground skin increased, was also evident in cooking loss (Table 1).

Time had an apparent effect on moisture values, but the differences were determined to be nonsignificant. The moisture values fluctuated as storage time increased and no definite pattern trends were established. Cooked turkey rolls may be frozen and stored with no significant loss or gain in moisture as time in storage progressed.

Table 3: Allo-Kramer shear values determined for cooked turkey rolls containing three levels of ground skin stored at 0°F (-18°C).

Percent skin	0	1	2	3	6	9	12	$\bar{X}$ for effect % skin
0	19.62**	13.83	18.42	23.00	21.39	22.91	22.46	20.23^{c}*
6	18.21	11.04	19.71	21.82	20.81	20.82	20.54	18.97^{b}
12	18.08	11.44	17.34	18.96	20.82	20.49	21.02	18.30^{a}
$\bar{X}$ for effect of time	18.60^{b}	12.10^{a}	18.48^{b}	21.26^{c}	21.00^{c}	21.40^{c}	21.33^{c}	$\bar{\bar{X}}$ 19.17 ± 4.51

$P < .99$

* Means of any column or row with the same letter are not significantly different at the 1% level of feasibility as judged by Duncan's New Multiple Range Test.

** Kg of force required to shear 3 mm slice and mean of 45 observations.

Time in storage, amount of ground skin, and the interaction between these two main factors had a highly significant effect on the shear values of turkey rolls (Table 3). As time in storage progressed, there was general increase in shear values. The initial shear value (18.60) and that determined after the second month of storage (18.48) were statistically the same, but the value determined after one month of storage (12.10) was significantly less. This reduction in shear value after the first month of storage with a corresponding

increase after the second month is evident regardless of the amount of skin incorporated into the rolls. This reduction shear values after a short storage with an increase in longer storage was also noted by Stadelman et al. (5). From the third month of storage until the end of the study there were no further significant changes in shear values.

The incorporation of 6 and 12% ground skin in the product resulted in highly significantly reduced shear values. This reduction in shear values was most prominent between those rolls with no ground skin and those containing 6% ground skin; but the reduction between 12% and 6% was not as great as the reduction between 6% and those rolls with no ground skin. These reduced shear values were evident regardless of time in storage except during the second month's evaluation where those rolls with 6% ground skin had a slightly higher shear value than those rolls containing no skin.

Table 4: Sensory Panel values for cooked turkey rolls containing three levels of ground skin and stored at 0°F (-18°C).

	Months in storage						
Attribute	0	1	2	3	6	9	12
Color	6.68^{d*}	6.31^{c}	5.99^{b}	5.99^{b}	5.93^{ab}	6.43^{cd}	5.62^{a}
Odor	6.62^{d}	6.28^{bcd}	5.94^{ab}	6.08^{b}	6.07^{b}	6.50^{cd}	5.63^{a}
Texture	6.40^{bc}	6.36^{bc}	6.17^{ab}	6.10^{ab}	6.14^{ab}	6.60^{c}	5.97^{a}
Flavor	6.45^{c}	6.15^{bc}	6.05^{ab}	5.85^{ab}	5.83^{ab}	6.37^{c}	5.59^{a}
Appearance	6.52^{d}	6.26^{bcd}	5.92^{ab}	5.90^{ab}	5.90^{ab}	6.36^{cd}	5.56^{a}

$P < .99$

* Any mean not followed by the same common letter in a row differs significantly at the 1% level of probability as determined by Duncan's New Multiple Range Test.

* Average 45 observations and sensory values rated on a 1 to 9 scale; 9 = excellent and 1 = extremely poor.

Time was the only variable to have a significant effect ($P < .99$) on sensory values (Table 4). The amount of ground skin incorporated into the turkey rolls had no influence on any attribute rated by the sensory panel regardless of the level of probability.

As time in storage progressed, a general decrease in all sensory attributes was evident. At the ninth month an increase in all sensory attributes was noted which were not significantly different from the scores at the initial starting period. The twelfth month of storage showed a decrease in all sensory attributes to below those sensory scores determined at the sixth month storage. The increase at the ninth month in sensory values may be related to the decreased shear values (Table 3). Stadelman also noted this increase in sensory attributes and speculated that there may be a seasonal preference for turkey (5).

Since the ninth month sensory panel was conducted during the middle of October, these increased sensory attributes could possibly be due to seasonal preferences. The most probable cause for the increased sensory panel values can be related to the larger standard deviation determined for the other months of storage and lower deviation for the ninth month.

Table 5: Hunter color "L" values for light and dark meat of cooked turkey rolls containing three levels of ground skin and stored at 0°F (-18°C).

	Months in Storage						
Meat	0	1	2	3	9	12	
Light	66.09^{b}*	66.22^{b}	63.78^{a}	65.03^{ab}	64.60^{ab}	63.82^{a}	64.52^{ab}
Dark	46.43^{ab}	48.12^{bc}	47.30^{abc}	48.71^{c}	47.71^{abc}	45.74^{a}	46.42^{ab}

$P < .99$

* Any mean not followed by the same common letter differs significantly at the 1% level or probability as determined by the Duncan New Multiple Range Test.

* Average of 36 observations.

The Hunter color "L" values are numerical evaluations between 0.00 for perfect black and 100.00 for perfect white. The meter light was randomly pinpointed on light and dark meat, and readings were taken separately. Only storage time had a significant effect ($P < .99$) on Hunter color "L" values (Table 5). The amount of skin added to cooked turkey rolls had no effect on Hunter color "L" value, and the lightness or darkness of cooked turkey rolls does not depend on the amount of ground skin in the product.

The light meat underwent a significant (P<.99) change, i.e., darker, between the first and second month. This was also noted in the sensory color values (Table 4). Between the second and twelfth months, the Hunter color "L" values of the light meat fluctuated, and no definite trends were established.

It was found that darkening of the light meat between the first and second month was also shown in the sensory panel scores for color and appearance (Table 4). This would tend to indicate that color sensory panel judgments of cooked turkey rolls are based mainly on the light meat of the roll.

The "L" value of the dark meat of the cooked turkey rolls did not show any definite trends, even though there was a significant (P<.99) difference between the third and ninth months.

Table 6: Hunter color "a" values for light and dark meat of cooked turkey rolls containing three levels of ground skin and stored at 0°F (-18°C).

	Months in storage						
Meat	0	1	2	3	6	9	12
Light	5.55^{bc}*	4.28^{ab}	5.02^{bc}	5.24^{bc}	3.76^{a}	4.25^{ab}	4.90^{bc}
Dark	8.13^{b}	6.76^{a}	7.05^{b}	7.51^{b}	5.81^{a}	7.29^{b}	6.21^{a}

P<.99

* Any mean not followed by the same common letter differs significantly at the 1% level of probability as determined by Duncan's New Multiple Range Test.

* Average of 36 observations.

The Hunter color "a" values determine the amount of redness and greenness of a product, i.e., the higher the number the more red the product and the lower the number the more green the product.

Table 6, shows the color "a" values for turkey rolls averaged over varying amounts of ground skin. Time was the only factor to have a significant (P<.99) effect on color "a" values. Increasing amounts of ground skin incorporated into the product had no effect on color "a" values. The light meat of the turkey rolls tended to have lower color "a" values (more greenness or less redness) as time in storage progressed, but this trend was not significant,

except for the value determined during the sixth month of storage (3.76). Dark turkey meat also had a definite drop in values as time in storage progressed. These decreasing color "a" values for dark meat were only significant when the initial, second, third, and fourth values are compared to the values found for the twelfth month (8.13, 7.05, 7.51, and 7.29 to 6.21). As found in the light meat, the color "a" value determined for dark meat at the sixth month of storage was less than the values determined for either the third or ninth month in both cases.

Table 7: Hunter color "b" values for light and dark meat of cooked turkey rolls containing three levels of ground skin and stored for 12 months at 0°F (-18°C).

	Months in storage						
Meat	0	1	2	3	6	9	12
Light	10.49[a]*	11.01[b]	10.54[a]	11.01[b]	11.49[c]	11.69[c]	11.53[c]
Dark	8.74[a]	9.67[b]	9.72[b]	9.90[b]	10.01[b]	9.89[b]	9.87[b]

P .99

* Any mean not followed by the same common letter differs significantly at the 1% level of probability as determined by Duncan's New Multiple Range Test.

* Average of 36 observations.

The Hunter color "b" values determine the amount of yellowness or blueness of a product, i.e., the higher the number the more yellow and the lower the number the more blue the product. Time was the only factor to have a significant effect on color "b" values determined for turkey rolls. Both the light and dark meat were found to have higher color "b" values as time in storage progressed. Between the third and sixth month of storage the most significant change in color "b" values occurred for light meat. This change for dark meat occurred between the initial observation and the first month of storage. These increased values were gradual, and neither the light nor dark meat indicated any radical change

SUMMARY AND CONCLUSIONS

As the amount of ground skin was increased, shear and moisture values decreased. The incorporation of 6% ground skin in the product resulted in a significant reduction in cooking loss, and an additional increase to 12% ground skin resulted in a further, but not significant, decrease in cooking loss. This reduction in cooking losses due to ground skin could possibly have a strong economic effect. Turkey rolls containing ground skin could be bought at a reduced price, and less loss during cooking would produce a larger yield leading to a reduction in the total amount of turkey rolls bought by the government.

Time in storage had a highly significant effect on sensory panel scores, Hunter color values and shear values. Sensory panel scores fell as time in storage progressed. The most significant reduction in panel scores occurred beyond six months of storage. Hunter color values tended to decrease as time in storage increased. Shear values decreased after one month in storage but beyond this point the values increased up to the third month in storage. After three months in storage no further significant change in shear values were observed.

Ground skin may be incorporated into cooked turkey rolls resulting in no decrease in quality or acceptance. Regardless of the amount of ground skin in turkey rolls, time in storage greatly affects the quality and acceptability of turkey rolls. Storage of turkey rolls at 0°F (-18°C) beyond six months results in decreased quality and acceptance.

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